

Improving Design Decision-Making Through A Re-Representation Tool For Visual Comfort Consideration In Dynamic Daylit Spaces

Dalia Hafiz
Virginia Tech

Introduction



Visual Comfort

"That state of mind that expresses satisfaction with the visual environment."

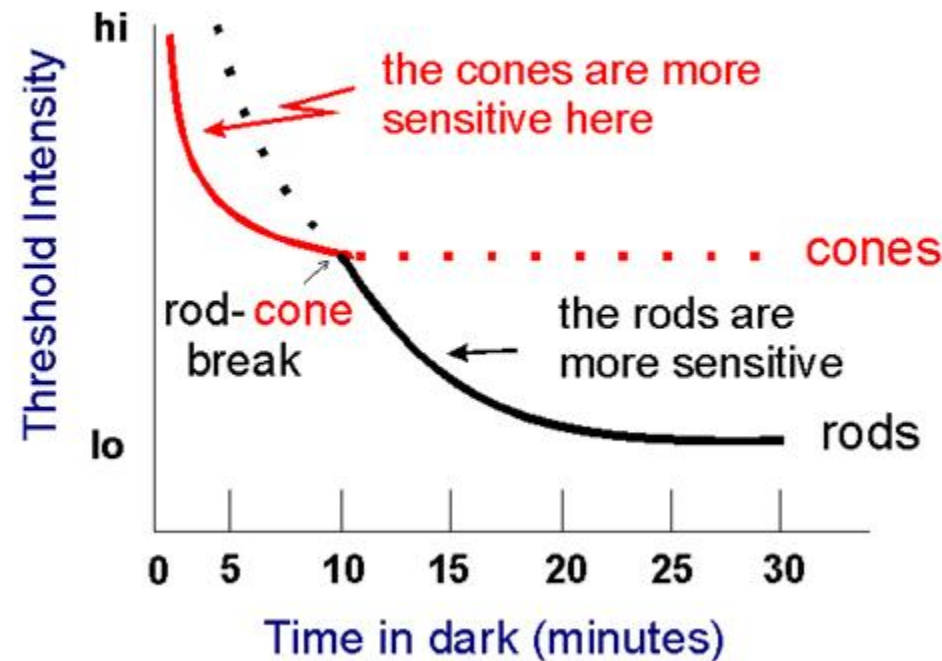
Walter Grondzik

Visual comfort is one of the key elements of lighting quality. Discomfort is most often caused by an excessive contrast in perceived brightness.

Visual Adaptation

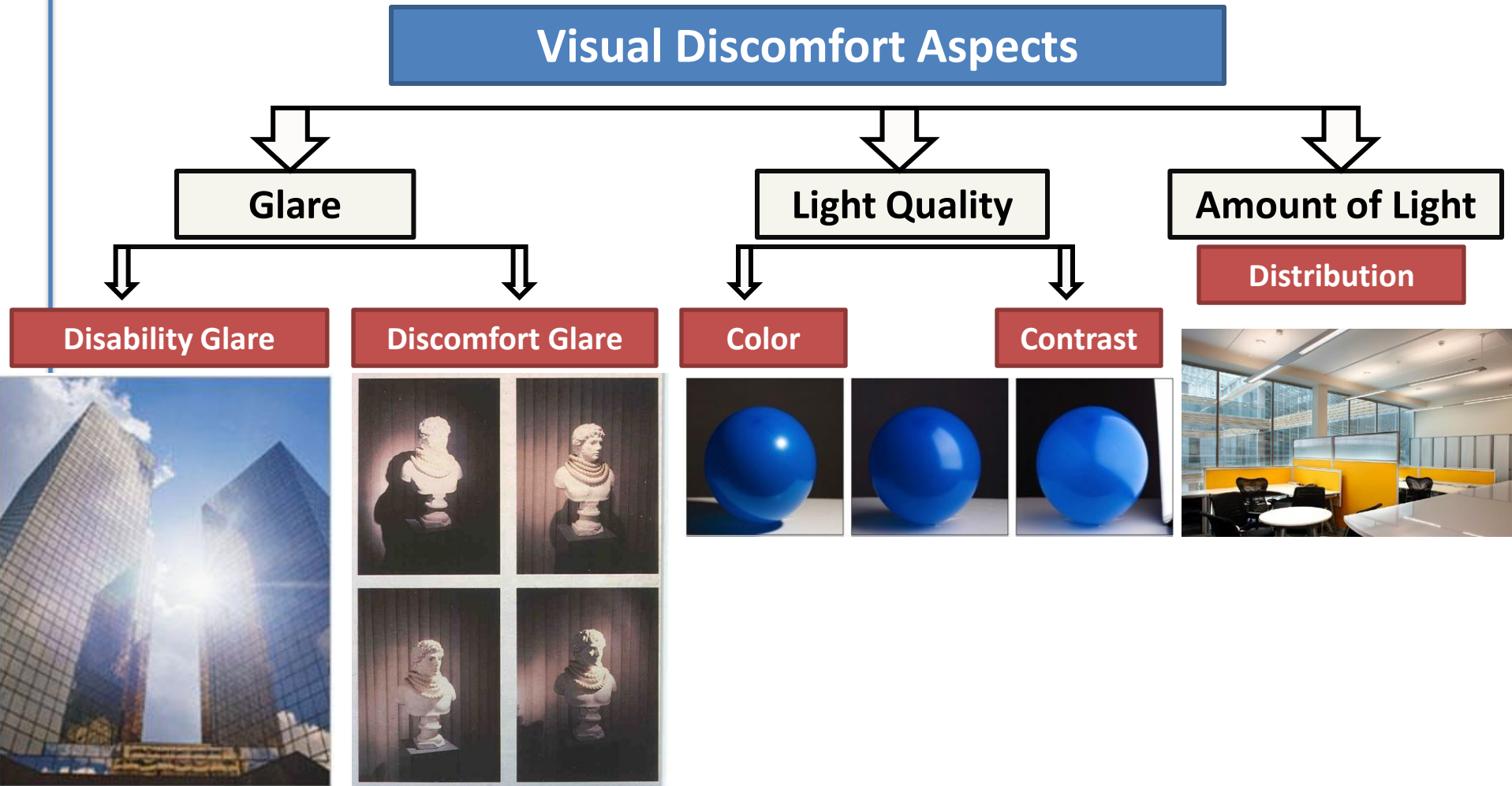


Visual system limits

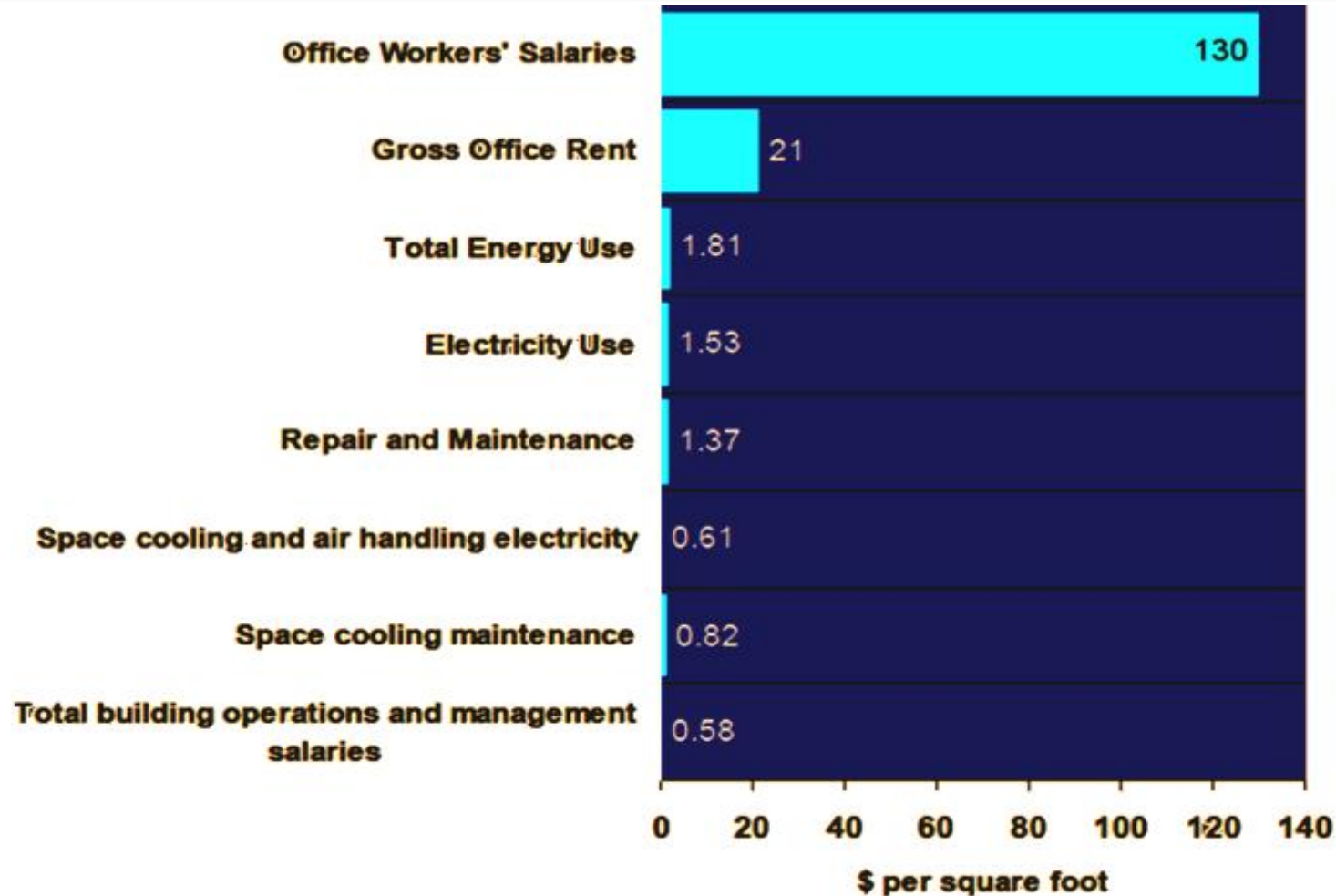


Visual adaptation

Aspects of Visual Discomfort

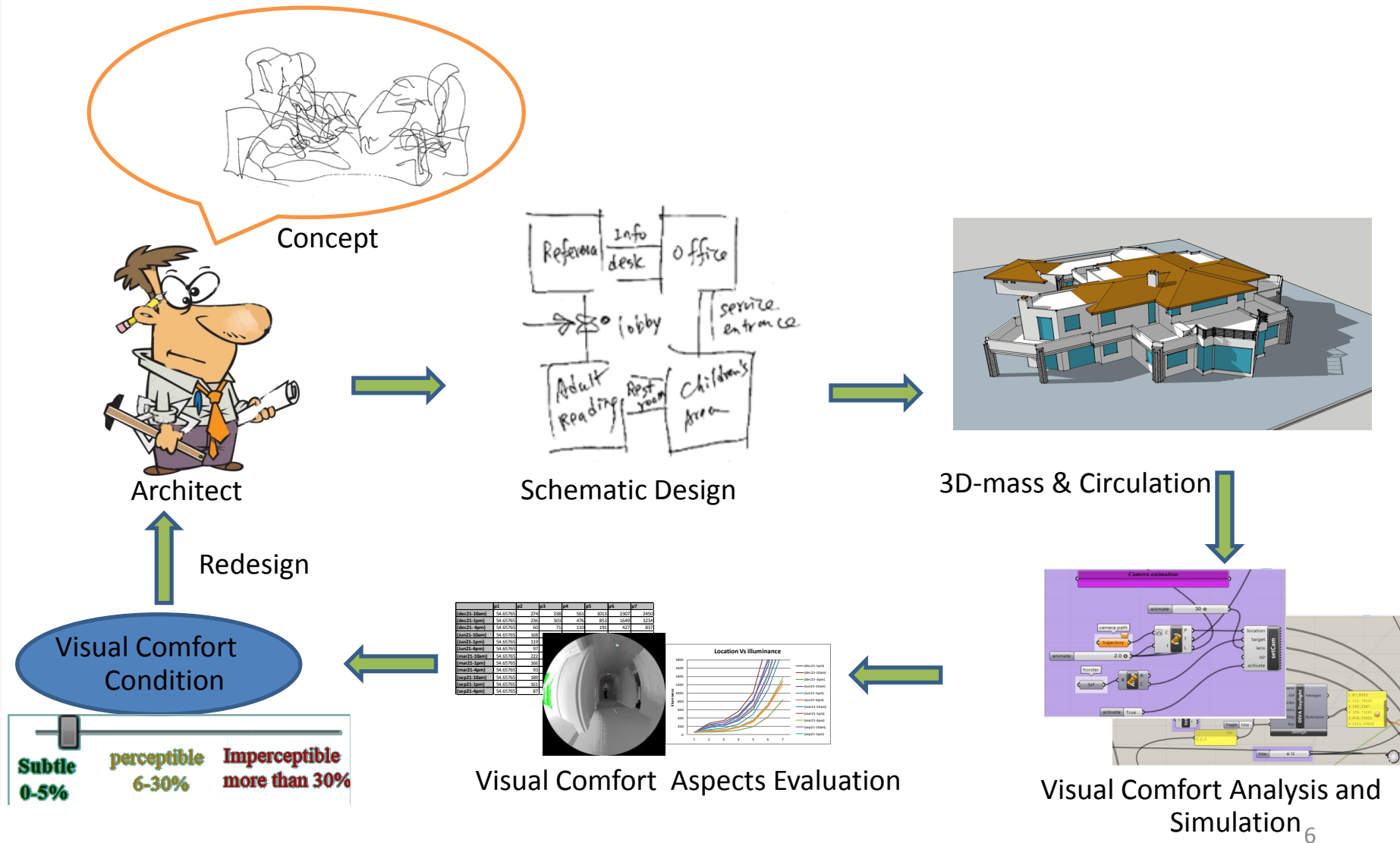


Why Study Visual Comfort??

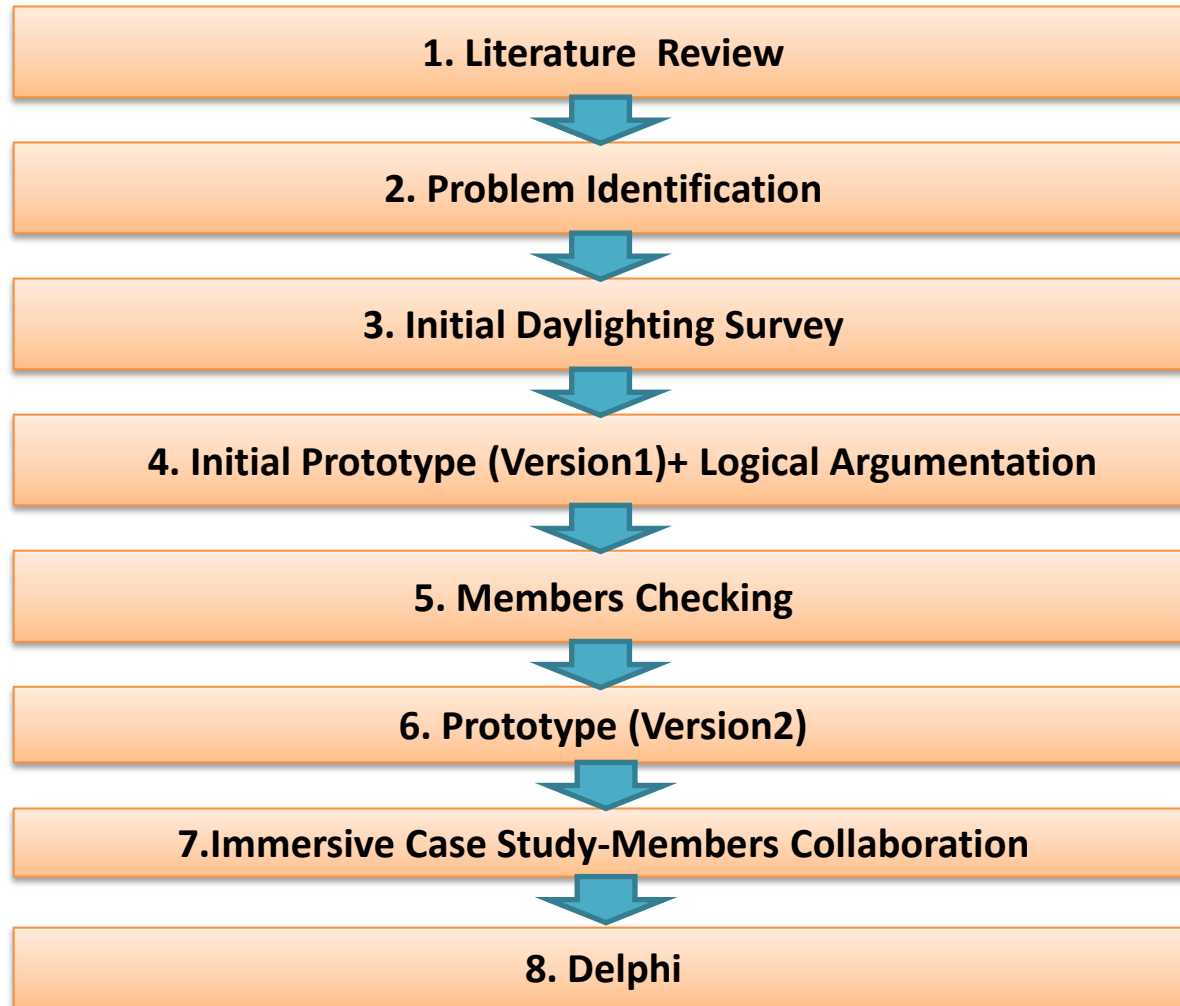


A study showed that occupants' salary represent the highest cost among all building energy consumption cost. Over a 30-year life, salaries account for 94% of a building's total cost ([Council, 2003](#))

Visual Comfort Evaluation

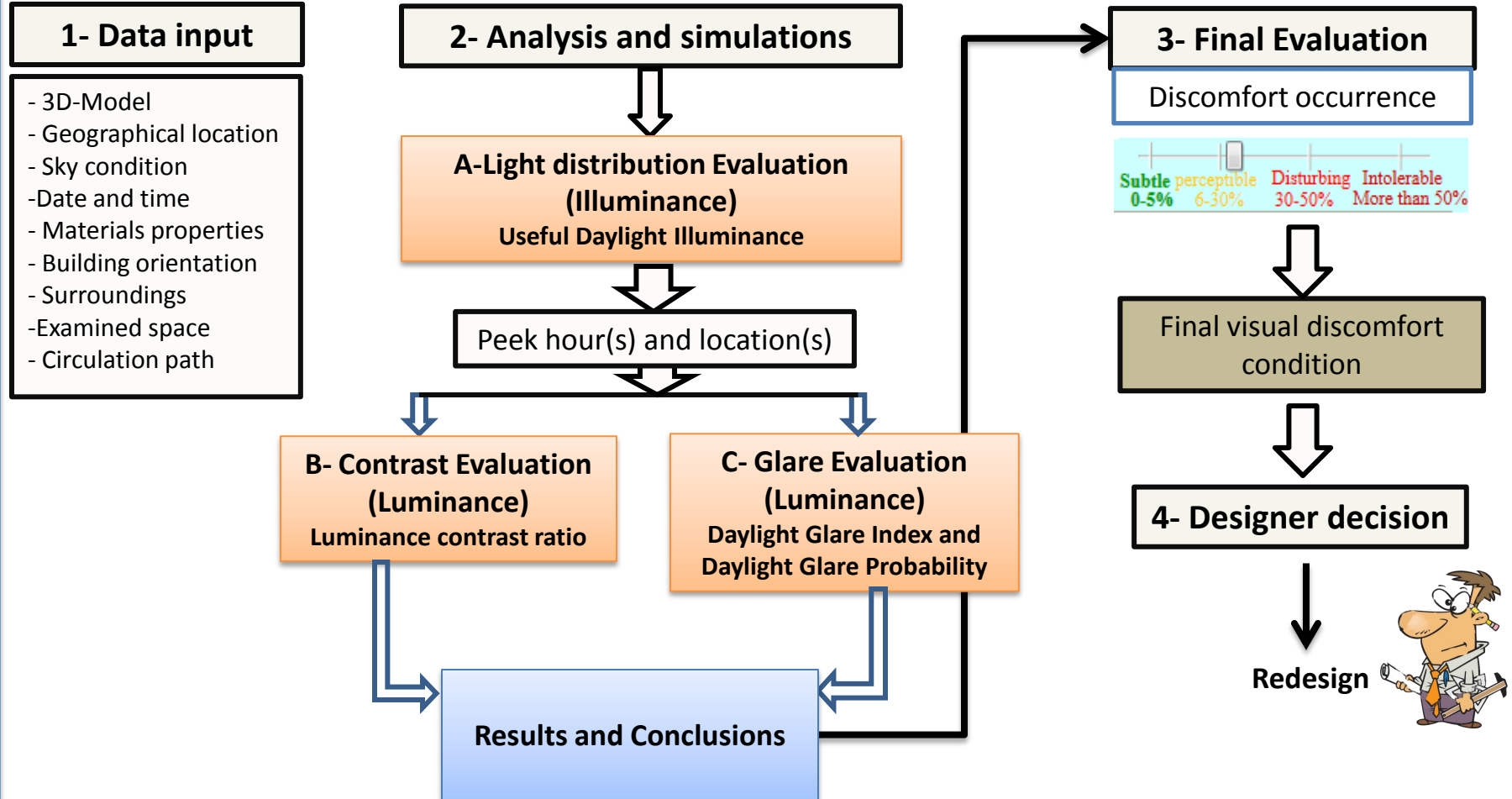


Tool Development Journey



Visual Comfort Evaluation Tool- Framework

Tool Framework Overview



Visual Comfort Evaluation Tool

1- Introduction

Download and Installation Instructions
Basic Definitions

2- Simulation Input

Geometry Circulation Passage
Days and times Geographical location

3- Evaluation Process

Evaluation Metrics Evaluation Results Representation
Visual Comfort Aspects Visual Comfort Condition

4- Final Visual Comfort Condition

Save results Final Designer decision
View different aspects effects



Dynamic Visual Comfort Evaluation Tool

INTRODUCTION

TUTORIALS

**PROCEED TO
EVALUATION**

Visual Comfort Evaluation Tool

Input DVCE Tool

Geometry MM/DD/T/Path Help?

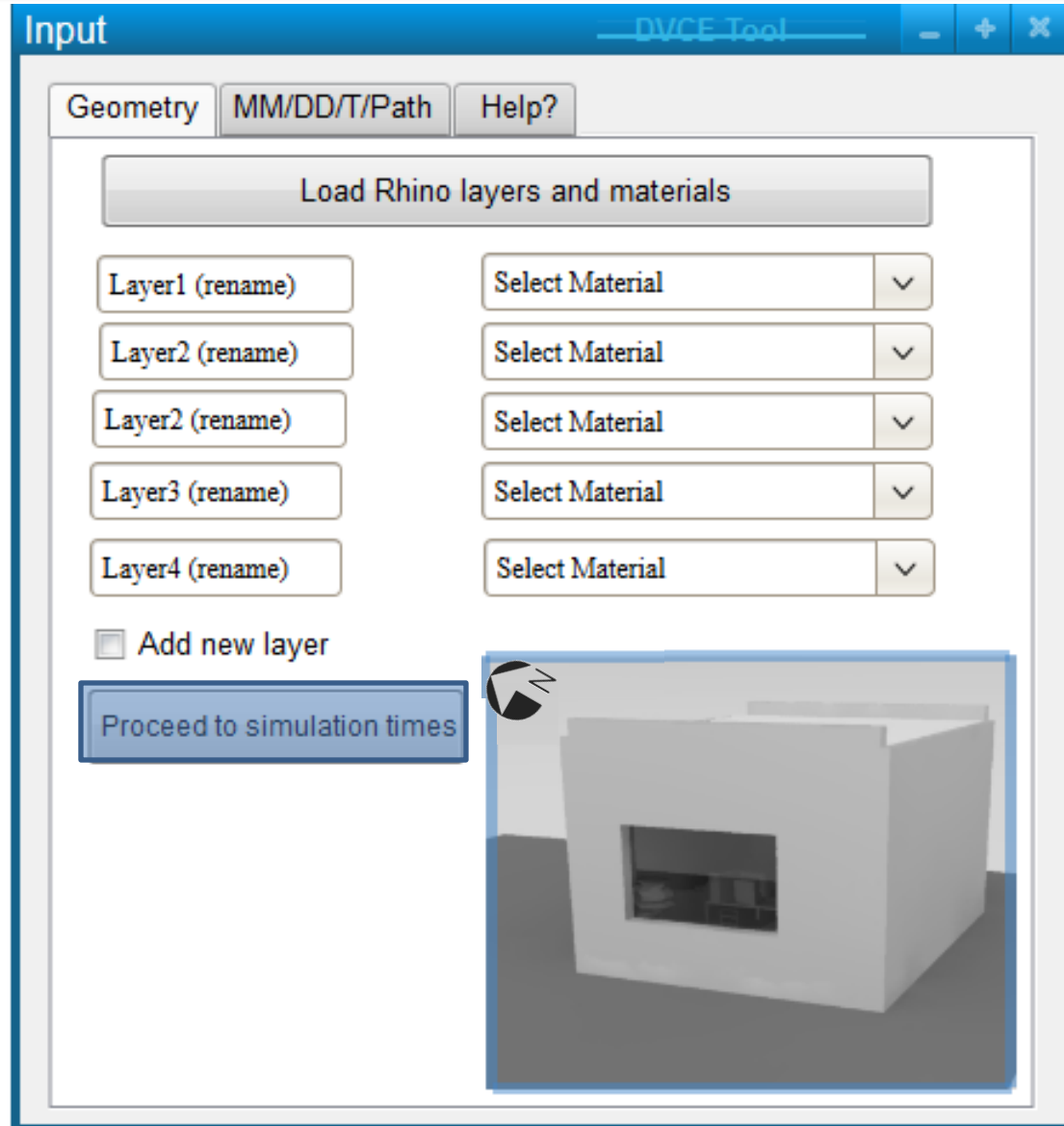
Load Rhino layers and materials

Layer1 (rename)	Select Material
Layer2 (rename)	Select Material
Layer2 (rename)	Select Material
Layer3 (rename)	Select Material
Layer4 (rename)	Select Material

☐ Add new layer

Proceed to simulation times

Visual Comfort Evaluation Tool



Dynamic Visual Comfort Evaluation Tool

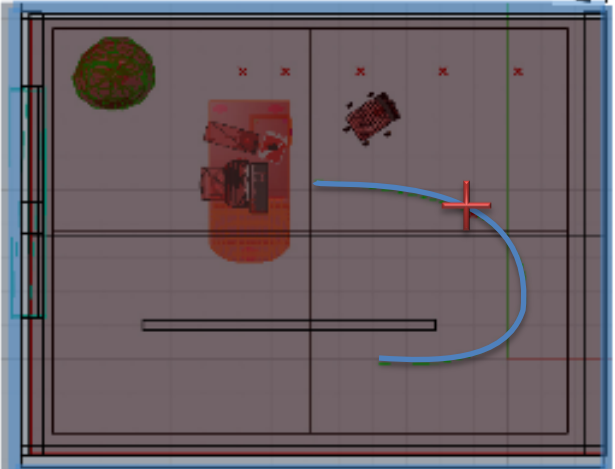
Input DVCE Tool

Geometry MM/DD/T/Path Help?

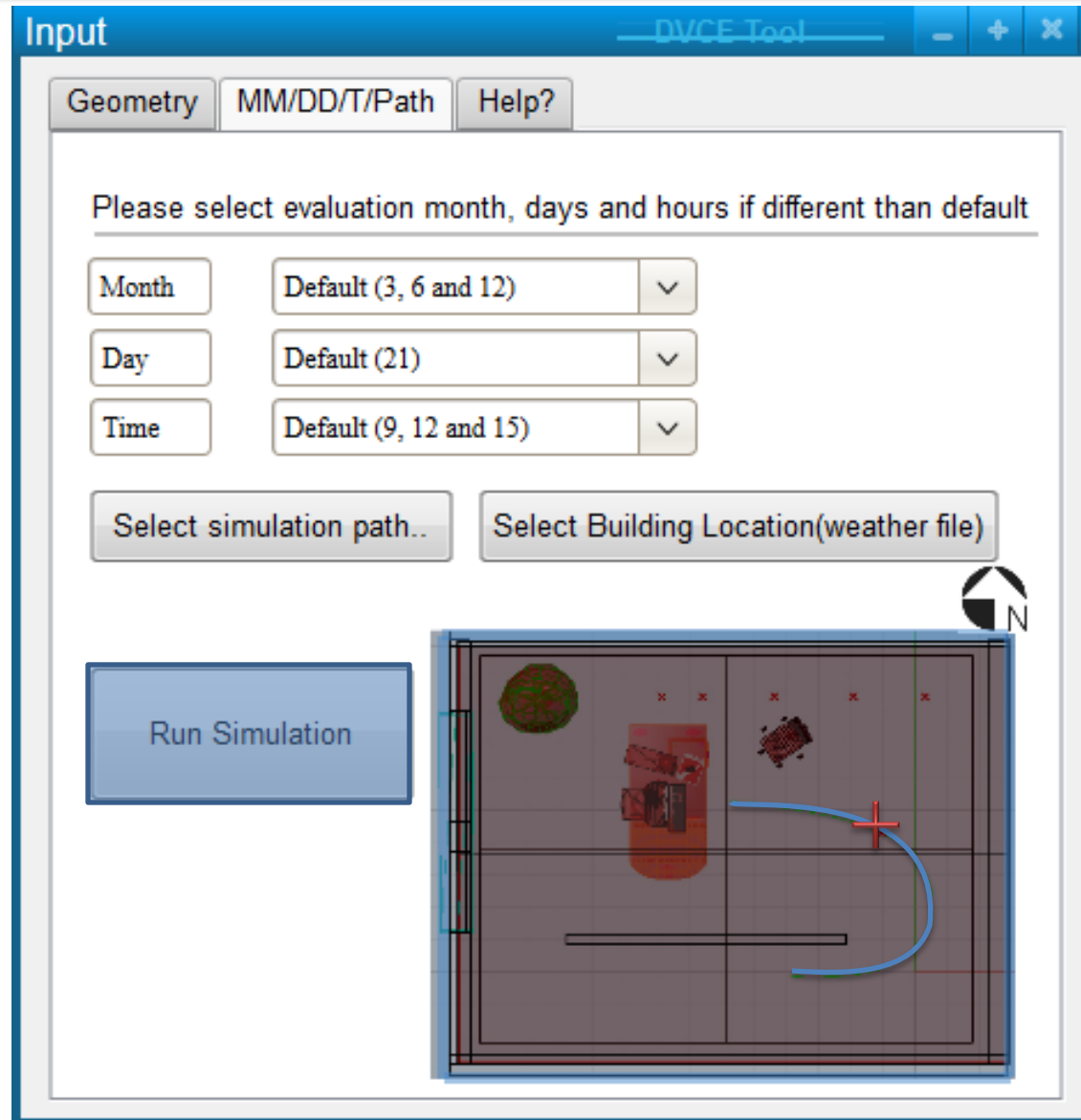
Please select evaluation month, days and hours if different than default

Month	Default (3, 6 and 12)	▼
Day	Default (21)	▼
Time	Default (9, 12 and 15)	▼

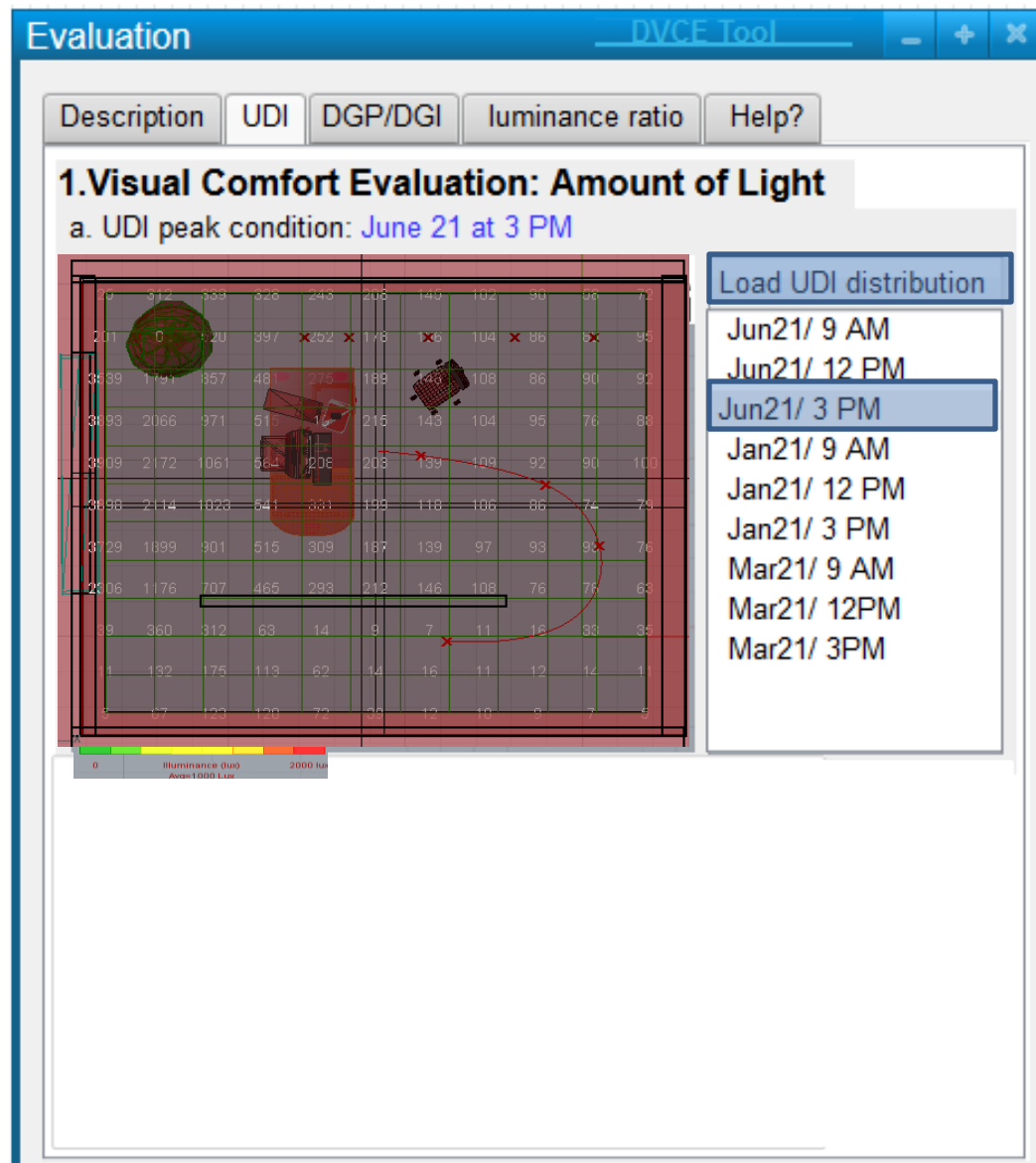
Select simulation path.. Select Building Location(weather file)



Dynamic Visual Comfort Evaluation Tool



Dynamic Visual Comfort Evaluation Tool



Dynamic Visual Comfort Evaluation Tool

Evaluation DVCE Tool

Description UDI DGP/DGI Luminance ratio Help?

2. Visual Comfort Evaluation: Glare

a. DGP(avg) condition: 0.20 = Subtle

Subtle perceptible Disturbing Intolerable
0.33 0.38 0.42 0.53

b. DGI(avg) condition: 18.4 = Perceptible

Subtle perceptible Disturbing Intolerable
<18 18 24 31

Play Passage Glare Evaluation

Dynamic Visual Comfort Evaluation Tool


Evaluation DVCE Tool

Description UDI DGP/DGI Luminance ratio Help?

3-Visual Comfort Evaluation: Light Quality

a.Luminance Ratio

DGP=0.190573



Luminance ratio avg:1:2:6

Luminance Ratio			
0	0.27217,	0.412232,	0.660233
1	0.419829,	0.477184,	0.87980
2	0.45797,	0.487904,	0.938647
3	0.258918,	0.375808,	0.68896
4	0.292821,	0.347811,	0.84189
5	0.338773,	0.343749,	0.98552
6	0.265591,	0.326168,	0.81427
7	0.626312,	0.597256,	1.04865

central zone: adjacent zone: non-adjacent zone= 1:3:10

Light Quality effect: Subtle

Dynamic Visual Comfort Evaluation Tool

Evaluation Results DVCE Tool

Description Luminance ratio glare points DGI Final condition Help?

Final Evaluation result

Perceptible Glare*

Subtle 0-5% perceptible 6-30% Disturbing 30-50% Intolerable More than 50%

Play walkthrough video

June21- (9AM)
June21- (12 Noon)
June21- (3PM)

Apply Effects

DGP ☐
DGI ☐
Central vision ☐

Play video

Save Results Place Building on Google Earth Evaluate Another Design

*Perceptible Daylight Glare Index (DGI): there is perceptible glare sensation

THANK YOU!

Dalia Hafiz
dalia1@vt.edu
Tel:862-579-7858